

# High Energy Theory Overview

## Michael Creutz

### Current members

- “permanent”

Michael Creutz

Sally Dawson      Department Chair

William Kilgore

William Marciano

Frank Paige

Amarjit Soni      Group Leader

Larry Trueman

- postdocs

Mu-Chun Chen —> Chris Jackson

Tadas Krupovnickas

Denis Suprun

- just graduated student

Brian Field

## Main strengths

- lattice and non-perturbative field theory Creutz, Soni
- higher order perturbative QCD Kilgore
- supersymmetric phenomenology Paige, Krupovnickas
- neutrino physics Chen, Marciano
- spin physics Trueman
- unified model building Chen, Dawson, Field, Suprun
- future accelerators Dawson, Field, Paige, Kilgore, Krupovnickas, Marciano, Suprun

Strong connections with experiment

## Recent group publications (2004- )

- K. Agashe, G. Perez and A. Soni, “Flavor structure of warped extra dimension models,” Phys. Rev. D 71, 016002 (2005) [arXiv:hep-ph/0408134].
- K. Agashe, G. Perez and A. Soni, “B-factory signals for a warped extra dimension,” Phys. Rev. Lett. 93, 201804 (2004) [arXiv:hep-ph/0406101].
- Y. Aoki *et al.*, “Lattice QCD with two dynamical flavors of domain wall fermions,” arXiv:hep-lat/0411006.
- K. A. Assamagan *et al.* [Higgs Working Group Collaboration], “The Higgs working group: Summary report,” arXiv:hep-ph/0406152.
- D. Atwood, S. Bar-Shalom and A. Soni, “Neutrino masses, mixing and leptogenesis in a two Higgs doublet model for the third generation,” arXiv:hep-ph/0502234.
- D. Atwood, T. Gershon, M. Hazumi and A. Soni, “Mixing-induced CP violation in  $B \rightarrow P(1) P(2)$  gamma in search of clean new physics signals,” Phys. Rev. D 71, 076003 (2005) [arXiv:hep-ph/0410036].
- D. Atwood, S. Bar-Shalom and A. Soni, “Seesaw induced electroweak scale, the hierarchy problem and sub-eV neutrino masses,” arXiv:hep-ph/0408191.
- S. Baek, P. Hamel, D. London, A. Datta and D. A. Suprun, “The  $B \rightarrow \pi K$  puzzle and new physics,” Phys. Rev. D 71, 057502 (2005) [arXiv:hep-ph/0412086].

- B. L. G. Bakker, E. Leader and T. L. Trueman, “A critique of the angular momentum sum rules and a new angular momentum sum rule,” Phys. Rev. D 70, 114001 (2004) [arXiv:hep-ph/0406139].
- F. Berruto, T. Blum, K. Orginos and A. Soni, “Neutron electric dipole moment with domain wall quarks,” Nucl. Phys. Proc. Suppl. 140, 411 (2005) [arXiv:hep-lat/0411003].
- M. Biglietti *et al.*, “Full supersymmetry simulation for ATLAS in DC1,” LBNL-55641
- T. E. Browder and A. Soni, “Search for new physics at a super-B factory,” Pramana 63, 1171 (2004) [arXiv:hep-ph/0410192].
- J. Campbell *et al.*, “Higgs boson production in association with bottom quarks,” arXiv:hep-ph/0405302.
- M. C. Chen and K. T. Mahanthappa, “Relating leptogenesis to low energy flavor violating observables in models with spontaneous CP violation,” Phys. Rev. D 71, 035001 (2005) [arXiv:hep-ph/0411158].
- M. C. Chen and K. T. Mahanthappa, “Fermion masses and neutrino oscillations in  $\text{SO}(10) \times \text{SU}(2)\text{F}$ ,” arXiv:hep-ph/0409165.
- M. C. Chen and S. Dawson, “The littlest Higgs model and one-loop electroweak precision constraints,” arXiv:hep-ph/0409163.
- M. C. Chen and K. T. Mahanthappa, “Lepton flavor violating decays, soft leptogenesis and SUSY  $\text{SO}(10)$ ,” Phys. Rev. D 70, 113013 (2004) [arXiv:hep-ph/0409096].

- H. Y. Cheng, C. K. Chua and A. Soni, “Effects of final-state interactions on mixing-induced CP violation in penguin-dominated B decays,” arXiv:hep-ph/0502235.
- H. Y. Cheng, C. K. Chua and A. Soni, “Final state interactions in hadronic B decays,” Phys. Rev. D 71, 014030 (2005) [arXiv:hep-ph/0409317].
- M. Creutz, “Spontaneous CP violation and quark mass ambiguities,” arXiv:hep-lat/0410043.
- M. Creutz, “Positivity and topology in lattice gauge theory,” Phys. Rev. D 70, 091501 (2004) [arXiv:hep-lat/0409017].
- M. Creutz, “Simulating quarks,” Comput. Sci. Eng. 6, 80 (2004).
- M. Creutz, “Are magnetic monopoles hadrons?,” arXiv:hep-lat/0408013.
- M. Creutz, “Ambiguities in the up-quark mass,” Phys. Rev. Lett. 92, 162003 (2004).
- M. Creutz, “Yang-Mills fields and the lattice,” arXiv:hep-lat/0406007.
- A. Czarnecki, W. J. Marciano and A. Sirlin, “Precision measurements and CKM unitarity,” Phys. Rev. D 70, 093006 (2004) [arXiv:hep-ph/0406324].
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- S. Dawson, “Perspectives on the standard model,” AIP Conf. Proc. 753, 3 (2005) [arXiv:hep-ph/0411276].

- S. Dawson, C. B. Jackson, L. Reina and D. Wackerlo, “Higgs boson production with bottom quarks at hadron colliders,” arXiv:hep-ph/0409345.
- S. Dawson, C. B. Jackson, L. Reina and D. Wackerlo, “Higgs boson production with one bottom quark jet at hadron colliders,” Phys. Rev. Lett. 94, 031802 (2005) [arXiv:hep-ph/0408077].
- S. Dawson and M. Oreglia, “Physics opportunities with a TeV linear collider,” Ann. Rev. Nucl. Part. Sci. 54, 269 (2004) [arXiv:hep-ph/0403015].
- S. Dawson, D. Dicus, C. Kao and R. Malhotra, “Discovering the Higgs bosons of minimal supersymmetry with muons and a bottom quark,” Phys. Rev. Lett. 92, 241801 (2004) [arXiv:hep-ph/0402172].
- A. Dighe *et al.*, “Working group report: Low energy and flavour physics,” Pramana 63, 1359 (2004).
- B. Field, “Associated production of A0 and Z0 bosons and rare pseudoscalar Higgs decays,” arXiv:hep-ph/0502195.
- B. Field, “Higgs boson resummation via bottom quark fusion,” arXiv:hep-ph/0407254.
- B. Field, “Next-to-leading log resummation of scalar and pseudoscalar Higgs boson differential cross-sections at the LHC and Tevatron,” Phys. Rev. D 70, 054008 (2004) [arXiv:hep-ph/0405219].
- S. . ( Hashimoto *et al.*, “Letter of intent for KEK Super B Factory,” KEK-REPORT-2004-4
- W. B. Kilgore, “Subtraction terms for hadronic production processes at next-to-next-to-leading order,” Phys. Rev. D 70, 031501 (2004) [arXiv:hep-ph/0403128].

- W. J. Marciano, “Long baseline neutrino oscillations and leptonic CP violation,” Nucl. Phys. Proc. Suppl. 138, 370 (2005).
- W. J. Marciano, “Precision electroweak measurements and the Higgs mass,” arXiv:hep-ph/0411179.
- J. P. Miller *et al.* [EDM Collaboration], “A new experiment to measure the muon electric dipole moment,” AIP Conf. Proc. 698, 196 (2004).
- W. J. Marciano, “Anomalous magnetic moments,” Int. J. Mod. Phys. A 19S1, 77 (2004).
- W. J. Marciano, “Muonium lifetime and heavy quark decays. (Lessons learned from muonium),” arXiv:hep-ph/0403071.
- W. J. Marciano, “Precise determination of  $|V_{us}|$  from lattice calculations of pseudoscalar decay constants,” Phys. Rev. Lett. 93, 231803 (2004) [arXiv:hep-ph/0402299].
- S. Prelovsek, C. Dawson, T. Izubuchi, K. Orginos and A. Soni, “Scalar meson in dynamical and partially quenched two-flavor QCD: Lattice results and chiral loops,” Phys. Rev. D 70, 094503 (2004) [arXiv:hep-lat/0407037].
- R. Sturrock *et al.* [ATLAS DC1 Task force Collaboration], “A step towards a computing grid for the LHC experiments: ATLAS data challenge 1,” CERN-PH-EP-2004-028
- D. A. Suprun, “Phenomenology of charmless hadronic B decays,” Nucl. Phys. Proc. Suppl. 142, 159 (2005) [arXiv:hep-ph/0410311].

## Substantial recent shrinkage

- 2.5 senior positions

Sally Dawson → “department”

Robert Pisarski → nuclear theory

Larry Trueman → part time

- not replaced
- travel/visitors strongly restricted
- consistent with general shrinkage of HEP at BNL

## Compensating factors

- new lattice gauge group (Karsch) 2 →~ 4 people
- growing nuclear theory group
- strong RBRC group
- QCDOC
- APS
- condensed matter theory

~ 60+ associated theorists

- A world class place to be a theoretical physicist!



C. Creutz

Between HEP, NT, Lattice group, RBRC, APS: 18 lattice people

- BNL is a premier place to do lattice physics!

## QCDOC

- substantial HEP contribution
- separate review May 24-25

## SciDAC (Scientific Discovery through Advanced Computation)

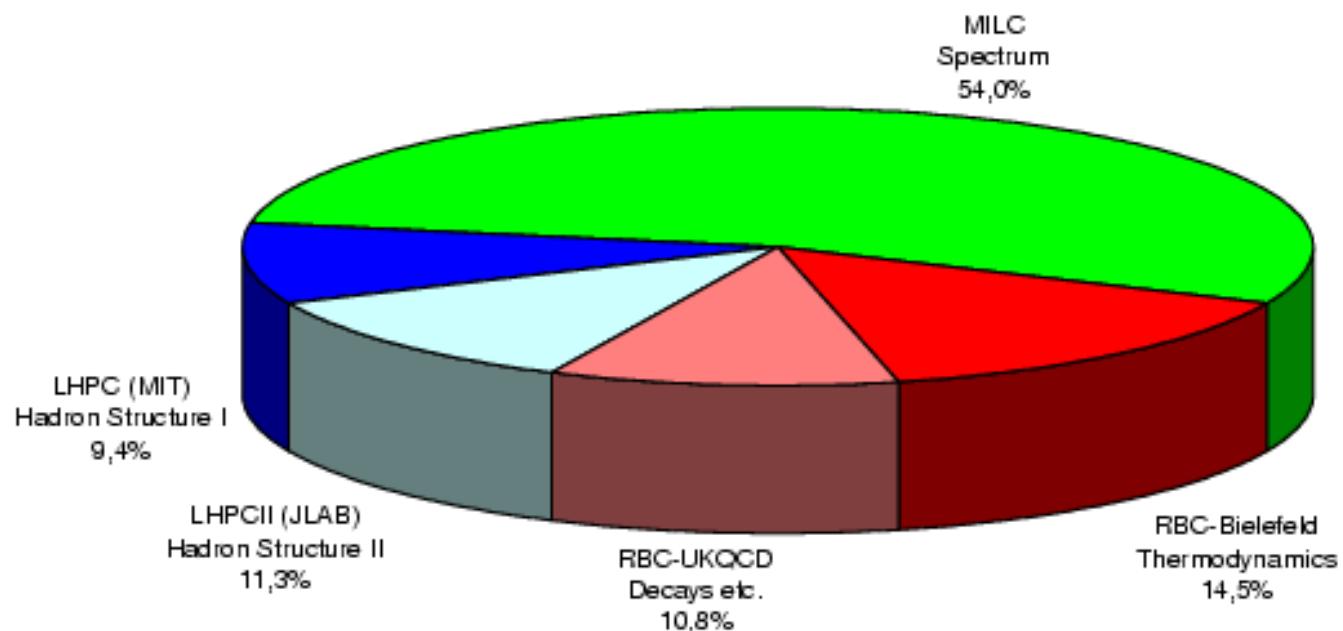
- postdoc: Konstantin Petrov —> Enno Scholz
- junior staff: Chulwoo Jung

## UKQCD, RIKEN, DOE machines assembled

- 12K+ processors each
- power PC plus communication on a single chip
- starting production runs
- CPS Dirac inverter  $\sim 40\%$  of peak
- MILC code  $\sim 20\%$  of peak



### Allocation on DOE-QCDoc



# Needs and desires

# Hope for stability



# Top-heavy group needs eventual balancing

- additional postdoc (lattice?)
  - junior staff

## Security (not just a BNL problem)

- one month to get non-US visitors on site; including SUNY students!  
(details on specific cases available)
  - crippling spontaneous exploitation of new ideas
  - many foreigners refuse to come to the US